Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

APPENDIX.

[The following articles, read at the meeting in 1883, were received (April, 1885,) too late for insertion in their proper places, and are given here.—SECRETARY.]

THE AGE OF KANSAS.

BY B. B. SMYTH, TOPEKA.

(Read before the Academy of Science, at Topeka, November, 1883.)

The altitude of the State of Kansas varies from 750 feet above the level of the sea at the mouth of the Kaw, to about 4,000 feet near the northwest corner. The west line of the State averages about 3,000 feet higher than the east line, thus giving an average slope from west to east of about 7½ feet to the mile. The slope or fall in the western part of the State is greater than in the eastern part. The average fall, however, of the Kaw and Arkansas rivers, except in the western part of the State, is somewhat less than 7½ feet to the mile, owing to their devious courses.

ROCKS.

The rock system of Kansas is exceedingly simple, commencing in the southeast corner with the sub-carboniferous, and ending in the northwest corner with the pliocene tertiary. Over almost the entire State the rocks are monoclinal and dip gently to the northwest at an average rate, in the central part of the State, at least double the average slope of surface to the southeast; though further west there is scarcely any perceptible dip in most places, and in others slightly to the northeast. And so far as I am aware, west of Topeka there is not a fault, fissure, fold or displacement of any consequence*. Evidences of non-conformability are only very slight†. These things, however imperfectly known at present, will be better known after there has been a systematic geological survey of the State.

With the successive strata thus lying in natural and undisturbed positions, the calculation of a problem of time becomes a comparatively simple one, depending, for its accuracy, upon the care taken in the investigation, or the proper observance of the data at hand.

CALCULATION.

Whether the strata of rock were as thick at the Missouri State line as at their present outcrop in Kansas, I have no means of judging; but, in the absence of any opposing testimony, we may assume that they were the same. Adopting the estimates of St. John as most trustworthy, I find that the thickness of the outcrop from northwest corner to southeast corner is over 6,000 feet, from which the average outcrop from the west line to the east line may be figured at 5,000 feet.

Now, considering that superposed strata to the amount of say 300 feet have been washed away at the northwest corner, this would make an average of 670 feet washed away along the west line of the State and 5,670 feet along the east line, thus making an average of 3,170 feet, or fully three-fifths of a mile in thickness over the entire State, equal to, since the State is 396 by 208 miles in area, a total of 50,000 cubic miles of earth

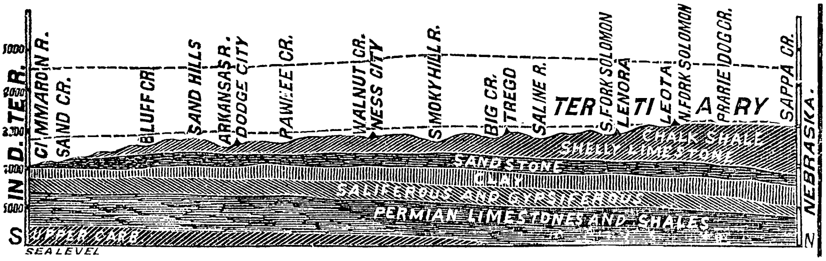
---

* Mudge, 1st Bien. Rep. Kan. St. Bd. Agr.

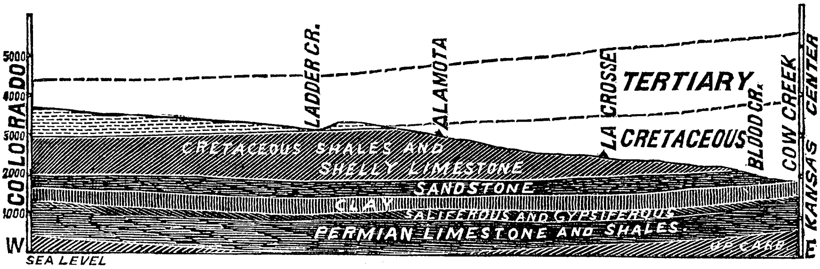
† Hay, present meeting, and St. John, 3d Bien. Rep. K. S. B. Agr.

VERTICAL SECTIONS THROUGH KANSAS.

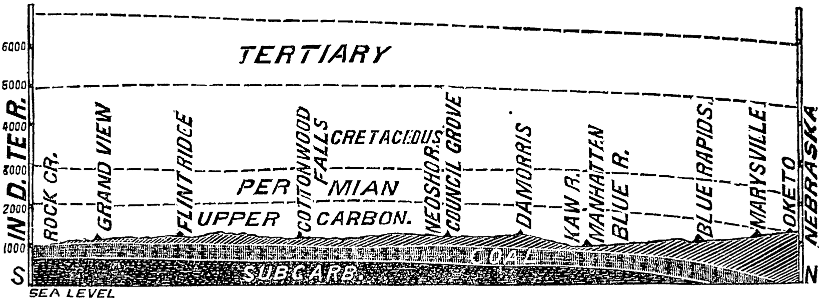
(Horizontal scale, 50 miles to the inch. Vertical scale, 5,000 feet to the inch.)



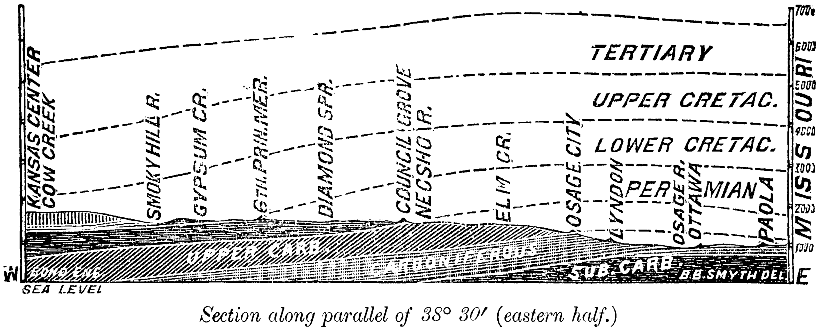
Section along 100th meridian.



Section along parallel of 38° 30′ (western half of State.)



Section along meridian of 96° 40′.



Section along parallel of 38° 30′ (eastern half.)

and disintegrated rock washed entirely away and carried to the ocean, or more properly, perhaps, the Gulf of Mexico. As a matter of fact, it was much more than that; for, where evidences of non-conformability appear between strata, it shows that there the surface at one time underwent a period of denudation and subsequent subsidence and immersion and consequent accumulation by deposition.

But, not counting what we do not see, what must have been the length of time required to remove the 50,000 cubic miles we do see, and carry the material utterly away?

Time is long. The existence of man is but a mere speck of time during this measurable portion of eternity.

SPECULATION.

If we may judge of the past by the present, the time occupied in the removal of the rock strata showing at the surface within the State of Kansas may be computed. No part of the surface of the State comprises any portion of the igneous rocks formed during the immeasurable past.* There are no outcropping rocks but those formed by sedimentary deposition.

No attempt, however, will be made in this paper to show the length of time elapsed during deposition. Arguments will be confined strictly to the time elapsed during degradation, whether continuous or interrupted.

In this article no presumption is made at accuracy of statement. No necessity exists for it. Figures will be given only in general terms and approximately. When it is remembered that an error in observation of even an inch in the depth of a river or the thousandth part of an inch in the depth of sediment deposited in a vessel of water, or of a week in the length of time a river should run during a year, might lead to an error of a million years, more or less, it will be observed how utterly futile an attempt at accuracy in these matters may be.

DEGRADATION.

The principal agents of degradation are water and air in motion. These will be considered in turn:

I.—*The Agency of Water.*

The rivers of the State carry off constantly earth in two forms — in suspension and in solution. Degradation by water, in Kansas, progresses mainly by two methods: 1st, by *denudation*, or washing of the surface; 2d, by *percolation*, or seeping — drawing out through springs, subterranean veins, etc. Both of these methods carry earth in the two forms named. The first carries mud and light earths in suspension and organic substances in solution; the second carries mainly sand in suspension and various alkaline salts and mineral matters in solution. The tendency or inclination, then, of surface water is acid, of spring water is alkaline.

The percentage of mud carried by a stream is greatest in a freshet; the percentage of sand carried is nearly always the same in the same stream; and the percentage of mineral matters held in solution is always greatest in low water, and the amount nearly always the same in a given river, whether the water is high or low.

A third method of degradation, namely *corrasion*, or the wearing away of the bed of a stream more rapidly than the surface of its basin, is still taking place to a small degree in the headwaters of the Kaw tributaries; in the bed of the Kaw itself very little; and in the Arkansas not at all.

The upper tributaries of the Kaw receive their load of earthy matters mainly by washing; the Kaw proper, Neosho and Osage partly by washing and partly by seeping; the Arkansas almost entirely by seeping.

The Arkansas bears evidence of being an older and maturer stream than the Kaw — perhaps because its bed is filled every summer with water from the mountains; perhaps because during each Platonic winter there may be many summer seasons when the Kaw is bound in ice that the Arkansas is free to run.

---

* Haworth, 8th Bien. Rep. Kan. Acad. Sci.

The greatest future change of surface will take place along the headwaters of the Kaw, where erosion is at present most brisk; the least future change will take place in the valley of the Arkansas, where erosion at present is but slight.

The earth that is carried down by the Kaw finds its way into the river mostly by the action of water. On the other hand, the earth that is carried down by the Arkansas from the surface of Kansas is carried into the river mostly by the wind. The clayey and alkaline portions are carried away quite readily; the sand goes out slowly. In winter, when north winds prevail, the Arkansas is dry, and the wind blows considerable sand out of the bed of the river, and makes ranges of sand-hills all along south of the river. In summer, when the prevailing winds are south, the river is filled with water and no sand is blown out. From Hutchinson to Arkansas City, over which course the river runs nearly south and is seldom dry, there are no sand-hills.

AREA.

The area drained by the Arkansas is 22,000 square miles in Kansas, and 26,000 in Colorado — 48,000 square miles in all. This does not include the territory drained by the Cimarron, etc. The area drained by the Kaw is 63,000 square miles, of which 36,000 square miles are in Kansas, 18,000 square miles in Nebraska, and 9,000 square miles in Colorado. The area drained by all other rivers is 24,000 square miles, all of which rivers have their headwaters within the State, except the Missouri and the Cimarron, neither of which need be considered except as on the borders of the State.

RAINFALL.

The rainfall of the basin drained by the Arkansas averages a depth of 22½ inches per annum, being 24 inches within the State, and 21 inches in Colorado. The rainfall of the Kaw basin averages 26 inches per year in Kansas, 23 inches in Nebraska, and 18 inches in Colorado — 24 inches for the entire basin. The rainfall of all other sections averages 30 inches per annum.

PRECIPITATION.

This would show that the average rainfall of the entire Arkansas basin, as far down as Arkansas City, Kas., is 2,450 billion cubic feet per annum, of which 1,269 billions fall in Colorado. The rainfall of the entire Kaw basin is 3,515 billion cubic feet, of which amount 1,340 billions fall in Nebraska and Colorado. The rainfall of all other streams is figured at 1,673 billion cubic feet, all of which is precipitated in the State. According to this, then, the total precipitation in Kansas amounts to 5,075 billion cubic feet in a year.

EVAPORATION.

Were evaporation and permeability of soil equal all over the State, discharge through the rivers would be in proportion to the rainfall. But it is well known that evaporation is greatest in the western part of the State, and permeability is greatest in the central part. From many experiments and constant observation made in Barton county, from 1874 to 1880, I determine that, though in many years, from Ellinwood west to the Colorado line, evaporation is greater than the rainfall, yet ordinarily there is a small excess of rainfall. Evaporation in the Arkansas valley averages 95 per cent. in Kansas, and 94⅓ per cent. in Colorado, averaging 94⅔ for that basin. Evaporation is 94 per cent. in the Kaw basin in Kansas, and 94¾ in Nebraska and Colorado, thus averaging 94¼ for the whole basin. The evaporation in the valleys of the Neosho, Osage, and other streams, is estimated at 92 per cent., which may possibly be too low. I have no means of knowing the proportion of seepage separately. It is included in the above figures for evaporation.

DISCHARGE.

I have not seen the Arkansas where it leaves the State, but from my information and knowledge of the stream, I estimate an average width of 840 feet, a depth of 1¼ feet for ten months in the year, and a velocity of 3⅓ miles per hour. Adopting this estimate, we find that 133 billion cubic feet of water would be discharged from the State, on an average, in the course of a year. Of this amount, 72 billion cubic feet is carried into the State from Colorado, leaving 61 billions to be collected in the State. The Kaw is not quite so wide as the Arkansas, but is very much deeper, and flows with about the same velocity; and, unlike the Arkansas, the bed is not filled with quicksand. Besides, the Kaw is never dry, as is the Arkansas, but flows all the year round. Yet I have no reliable data as to its average width and depth at its mouth. But calculating from the annual precipitation and evaporation, I find that the Kaw should discharge 201 billion cubic feet in a year, of which 70 billions come down from Colorado and Nebraska, leaving 130 billions to be gathered from the State. Similar calculation makes all other streams carry off 134 billion cubic feet, entirely from Kansas.

LOAD.

The amount of earth carried by a stream is in proportion to the square of the pitch or slope of surface of the earth multiplied by the excess of rainfall over evaporation and seepage, and divided by the comparative solidity of rocks or tenacity of the soil, or in other words, multiplied by the comparative friability and solubility of the earth and rocks. This omits one important factor — time, because of the difficulty and uncertainty of applying it. It is well known, for instance, that in a rainfall of three inches, distributed over three days and nights, the excess of rainfall would scarcely swell the streams, whereas a rainfall of three inches, precipitated in an hour, would carry torrents of muddy water and sand into the rivers. To put this formula into algebraic form it would appear thus:

$$l = \frac{r\,p^2\,f}{t^2} \quad \text{or} \quad l = \frac{r\ p^2}{s}$$

In which *l* represents the load of earth carried by the water; *r* is the excess of rainfall; *p* is the pitch of surface of the land; *f* is the comparative friability and solubility of the earth and rocks; *s* is the solidity or tenacity, and *t* is the time from the beginning of a rain to the end of it. However, this last factor (*t*) may be omitted, since it is only the excess of rainfall over evaporation and seepage which is considered. The term seepage, as used here, applies to that water which percolates through the earth deep enough to pass off in springs or subterranean streams, or lies quiet in the earth, and not to that water which soaks into the earth and is afterwards taken up by plants, or otherwise used or evaporated.

Repeated observations show that the waters of the Arkansas carry about one five-hundred-and-twenty-fifth of their bulk of earthy matter in suspension. A foot depth of water dipped from the Arkansas will, when settled, contain a deposit of nearly one-fortieth of an inch of soil. The amount in solution is undetermined as yet; but for the purposes of this article, may be figured at one-twentieth of the above amount, or enough to say the Arkansas carries one cubic foot of solid matter for every five hundred of water. The Kaw carries out one foot of solid matter for every six hundred and twenty-five cubic feet of water. The other streams of the State are estimated to carry off one foot of solid matter for every twelve hundred and fifty cubic feet of water.

Knowing, then, by experiment and deduction, the amount of water carried off by the different streams, and the comparative amount of solid matter contained therein, it is easy to arrive at the gross amount of earth removed from the State by its rivers in a year, thus: The Arkansas carries out 366,960 cubic feet of earth per hour, and in ten months, or 300 days, it carries out 266,000,000 cubic feet, of which 155,000,000 are brought down from Colorado, leaving 111,000,000 cubic feet to be taken from the State. The Kaw carries out yearly 322,000,000, of which 135,000,000 comes from Colorado and Nebraska, leaving 187,000,000 as its work within the State. The other streams carry off 107,000,000 cubic feet in a year. The total amount carried off by all the rivers is 695,000,000 cubic feet, of which 405,000,000 are removed from the surface of the State of Kansas each year. This is 15,000,000 cubic yards; truly an enormous amount, if it were carted off by human agency.

RATE OF DENUDATION.

Enormous as this amount may seem, at this rate of denudation it would take 470 years to remove a single inch from the entire surface of the State, and 5,640 years to remove one foot. Within the historic period of the era of man — say 6,000 years — the amount of rock and soil removed from the surface of the land between the Missouri river and the mountains, averages only one foot in depth.

We can look back and see readily enough through the dim vista of 6,000 years, and are quite able to see the same rivers, and the same rolling prairies; the same north and south winds; the same heavy rains of summer and dryness of winter; the same buffalo grass, with its cropping herds of buffalo; the same sparse cottonwoods and willows near the streams; the same limestone ledges in the western part of the State; the same sandstones and fire-clay in the center; the same traces of coal in the southeast. Some of the flinty-capped hills of Greenwood, Saline and other counties may seem now a very little taller than then, and an occasional sand-hill, south of the Arkansas, may be in a new position, but in general, the topography and climate are very much the same; except that now the earth is drier, there is less water in the rivers, and denudation is less rapid than then.

Since the last glacial epoch, assuming that the height of the glacial period was when the earth's perihelion occurred at or shortly after the summer solstice, say 11,342 years ago, the amount of degradation has scarcely reached an average of two feet. Can there be a more forcible argument presented to show that time is long? Truly, "the mills of the gods grind slowly; yet they grind exceeding small."

There has never been a time when our long, broad, tortuous valleys were filled to the brim with the waters of a foaming, rushing, abiding river. If there are evidences at the base of any cliff of its having been washed by water, it is because the little stream, now somewhere near the middle of the valley, was once washing its base. Most small rivers and streams, in the course of time, travel all over their valleys. For at every bend a stream is constantly encroaching upon the further bank and building up the near one. Constant change of this kind will cause a stream, in the course of time, to touch every part of the valley bottom, even to washing the base of an occasional bluff. The width that valleys now have has been attained by the slow process of weathering, at a rate, perhaps, not to exceed one or two inches in a century. The alluvial soil that fills the bottoms has been washed there from the uplands, and blown there by the winds, and blackened by animal and vegetable humus and the products of prairie fires.

But the evidences at hand show that a depth of 3,170 feet over the entire State has been washed away. At the rate of our calculation, which, in past æons, at least, will not probably hold good, this would require nearly 18,000,000 years to remove what has been removed. This is equal to 840 great perihelional cycles or Platonic years; 840 times that this land has endured a warm, sometimes a subtropical climate; 840 times that it has undergone the rigors of a glacial period, or been nearly immersed in the sea *since the deposition of the pliocene tertiary.* The mind stands appalled at the magnitude and meaning of these figures.

Was the rate of erosion during the great Platonic winter in the Arctic regions, or glacial period, as it is called, the same as at present? We judge of the past by the present. During our present annual winters, when the earth is frozen, the land covered with snow, and the rivers low and dry, erosion is reduced to a minimum. During the glacial period, evidence is not wanting of the presence of vast fields of ice as far south as 39° in the eastern part of the State, perhaps not during the last glacial period, but at other former times. North of lat. 39°, then, as in the headwaters of the Kaw, it is reasonable to presume that erosion would be less rapid; while farther south—as in the valleys of the Neosho and Arkansas, in consequence of the melting of much snow—erosion must have been greater. Following each glacial period in the great Platonic springtime, during the disappearance of the ice, and the greatly increased annual rainfall of those periods, even up to a few thousand years ago, erosion should be somewhat greater. Yet on the other hand, considerable soil and some bowlders have been deposited in northeastern Kansas by the action of the Missouri and by ice from the regions of the north, perhaps enough to neutralize the increased erosion. These considerations only modify the length of time of our calculation, and do not nullify it.

II.—*The Agency of Air.*

Air, like water, acts in a two-fold capacity: *First*, by taking up, on decomposition, the elementary constituents of the rocks; and *second*, by taking up and holding in suspense, and carrying bodily, particles of earth, sand, etc. It acts as an auxiliary to water by leveling the hills and filling the rivers; but it also carries earth entirely and forever out of the State.

It is known that, though the prevailing winds be north and south, the general tendency is from the west and toward the east. A particle of sand, though it may be blown north and south across the State a thousand times, will ultimately find its way out of the State toward the east; but by that time it has become worn so fine and has apparently so little grit as to be scarcely recognizable as a former resident of Kansas. Did it come from Colorado? Perhaps; but certainly not from beyond the Rockies.

As to the *amount* of soil that is removed, there are no statistics that are at all trustworthy. Let it suffice to say that exposed situations lose the most, and sheltered situations receive the most. Kansas is an exposed State, therefore it loses more soil than it receives, especially in the west. If it be admitted for the sake of argument, that even the one-thousandth part of an inch be removed in the course of one of our three-day dust storms, and that there are four such storms in a year, it will be seen that one inch would be removed in 250 years, which is twice as fast as the rate of erosion by water.

ILLUSTRATION.

During the spring of 1880 a notable dry dust storm, with a southwest wind, took place, that raised vast clouds of coarse sand, fine sand, and dust, the last two to great heights, and to such an extent as to partially obscure the sun all over the State of Kansas. At its close, a deposit of fine dust was observed to have taken place in Kansas City, St. Joseph, and even as far east as St. Louis. In conversation subsequently with our lamented Prof. Thomas, I learned from him that he caught some of the fine dust that fell in Topeka the night after the storm ended, examined it in the microscope, and found it to consist almost entirely of finely-comminuted silica; but where it came from he had no idea. I, on the other hand, at that time in Barton county, observed that on level prairies, all unprotected loose soil, mainly sand and light loam, even down to the grass roots, was taken up high in air and carried off; but where it went to I had no idea. Certainly an equal amount was not deposited from the opposite direction. Similar storms are quite frequent in western Kansas.

DEDUCTION.

The air, then, is an important factor in the removal of soil; though the rate of removal may not be computed.

RATE OF DEPOSITION.

The time required for deposition of the sedimentary rocks must greatly exceed that required for removal. For, the ocean being so much greater than the land, any quantity of soil removed from the land becomes very thin when spread out over the floor of the ocean. However, the rate of deposition is always very unequal, according to the varying conditions; and we know not what the conditions may have been during deposition of any of our older strata.

Evidences are abundant, showing that at various periods of the earth's development, portions of this continent were elevated above the surface of the sea, and removal of deposits continued, often until a greater depth of rock was removed than we have considered in this article, requiring either a greater time or more violent forces at work; and again, the land would become submerged, and remain buried until additional great depths of deposition had taken place, and new rocks were formed; thus showing repeated formation and removal of vast thicknesses of solid rock. If this be true of other parts, why not of Kansas?

AGE.

Counting time necessary for such successive deposits and removals, not counting varying conditions, can we safely estimate that, since disintegration and deposition first began on the igneous foundation rocks of Kansas, less than several hundred million years could have elapsed? Indeed it was probably very far beyond that toward eternity.

Time is long, and life is fleeting.

CLOSE.

In closing this paper, let me urge upon scientists in different parts of the State that they make occasional note of the following points: Breadth and depth of streams near where they live, at stated times; velocity of current, found by throwing in a chip, and noting time taken to pass a given point whose distance is known; amount of sediment obtained from a measured quantity of water; weight of residue obtained on boiling the water away; length of time the stream runs during the year, and time of year. Such observations, faithfully taken and recorded, will be very interesting and valuable.

SECOND CONTRIBUTION TO THE HERPETOLOGY OF KANSAS, WITH OBSERVATIONS ON THE KANSAS FAUNA.

BY F. W. CRAGIN, SC.B.

The list herewith given includes recent additions to my "Catalogue of Kansas Reptiles and Batrachians,"* together with further notes on certain species embraced in that catalogue.

For the identification of several of the species herein reported, I am indebted to Prof. E. D. Cope.

The remarks following the list are a revision and extension of notes, originally drawn up in the winter of 1880–81, to accompany the catalogue above mentioned, but finally withheld in order that the conclusions set forth in them might be made both more accurate and fuller. They make, even now, no claim to completeness.

Lack of time prevents me from entering here upon a full discussion of the details upon which these conclusions are based; but this I hope soon to be able to do in another paper.

---

*Transactions Kas. Acad. Sci., Vol. VII, p. 114.

Cistudo ornata, Ag.: Western Box-tortoise.—This little land tortoise is so abundant in some sections of southern Kansas, (*e. g.*, Harper and Barber counties,) as to amount to a nuisance as a cumberer of the ground.

It will probably have to be reduced to the rank of a variety, under *C. Carolinensis*, Linn. (=*C. clausa*, Gm.)

Chrysemys Belli, Gray: Bell's Tortoise.—Although this species, under the name of *Chrysemys Oregonensis*, was included in my "Preliminary Catalogue of Kansas Reptiles and Batrachians," (Transac. Kas. Acad. Sci., Vol. VII, 1881,) on the ground of its known general distribution, I was then unable to present any actual record of its occurrence within the State. I now find it to be the common *Chrysemys* of the streams in Shawnee county. It has also been submitted from Neosho Falls by Col. N. S. Goss, and I have taken it in Lake Farland, McPherson county. Through the kindness of Prof. Popenoe, of the State Agricultural College, I have also been able to examine specimens collected in the vicinity of Manhattan. In Dr. Yarrow's "Check-list of North-American Reptilia and Batrachia," I find the species recorded from the Republican river.

Chrysemys picta, Herm.: Painted Tortoise.—It now appears that the *C. Bellii* recorded by Agassiz (Contrib. Nat. Hist. U. S.) as abundant in western Missouri, and so quoted in the "Preliminary Catalogue" under the name *C. picta*, was probably the preceding species. But among the specimens from Neosho Falls, Kansas, submitted by Col. Goss, is one of the true *C. picta*, enabling me to retain the species as an undoubted member of the Kansas fauna.

Malacoclemmys Le Sueuri, Gray: Le Sueur's Map Turtle.—This is a common species in the Kansas river at Topeka. I have seen also, by favor of Prof. Popenoe, a specimen collected near Manhattan, and the species occurs in the collection from Neosho Falls from Col. N. S. Goss.

Pseudemys elegans, Pr. Max. Wied.: Red-Eared Terrapin.—A large specimen of this superb tortoise, "alive," though decapitated, and showing the marks of sharp teeth, was recently found by the writer upon the bank of Shunganunga creek near Topeka. It shows that even the best equipped specimens of these armor-clad reptiles sometimes fall a prey to the minks or other carnivorous mammals of our western streams. A young living specimen collected near Geuda Springs, has been received from Messrs. Harry and Walter Vrooman; and a third specimen is in the collections of the Kansas Academy of Science, contributed from Neosho Falls by Col. N. S. Goss.

Cinosternum Pennsylvanicum, Bosc.: Eastern Mud Turtle.—Through the courtesy of Prof. Popenoe, I have been able to examine the tortoises in the cabinet of the State Agricultural College. Among them I find a single specimen of this species. It was taken in Trego county by Mr. S. C. Mason.

Sceloporus undulatus, Harl., var. *Thayeri*, B. &. G.: Thayer's Alligator Lizard.—Received from McPherson county through Dr. John Rundström.

Sceloporus consobrinus, B. & G.: Marcy's Alligator Lizard.—In my former list I could quote only a Nebraska and an Indian Territory record as evidence that this lizard belonged to the Kansas fauna. A specimen from central Kansas has since been contributed to the Washburn zoölogical cabinet by Mr. Jerry B. Fields. It is a female, and represents, *fide* Prof. Cope, *S. Garmani*, Boul.

Cnemidophorus tessellatus, Say: Tessellated Swift.—The occurrence of this species in Kansas was hardly expected; but a specimen of the typical variety has been sent me from McPherson county, by Dr. John Rundström.

Eumeces fasciatus, Linn: Blue-tailed Skink.—A considerable number of specimens from Neosho Falls, presented by Col. N. S. Goss to Washburn College and the Kansas Academy of Science, includes the *erythrocephalus*, *quinquelineatus* and *fasciatus* phases, or rather ages, which were mistaken for distinct species by Dr. Holbrook.

Eumeces multivirgatus, Hallowell.—Neosho Falls; collected by Col. N. S. Goss. This skink was included in the supplement of my preliminary catalogue only as one rather likely to be found in Kansas.

Tropidonotus leberis, Linn., var. *Grahamii*, B. & G.: Graham's Queen Snake.—Neosho Falls; collected by Col. N. S. Goss.

Storeria lineata, Hallowell: Line Snake.—This is the *Tropidoclonium lineatum* of my preliminary catalogue. It proves to be one of the commonest serpents of Kansas. Every State has its "School-boy's Snake," a snake of small size and meek demeanor, though a horror to the uninitiated, which the untamed urchin of school and field carries about in his pocket or fist for purposes of terrorism. This "School-boy's Snake" of Kansas is the Line Snake.

Eutænia sirtalis, Linn., var. *Pickeringii*, B. & G.: Pickering's Garter Snake.—McPherson county, from Dr. John Rundström.

Eutænia sirtalis, Linn., var. *obscura*, Cope MSS.—Dr. Yarrow's Check-list shows that this variety of the Garter Snake ranges over the entire area of the United States. Eight of the specimens appear to have come from Kansas, the following localities being recorded: Cimarron river, a point between the Cimarron and the Arkansas, Republican river, and Little Blue river.

Eutænia proxima, Say: Long's Garter Snake.—Dr. Yarrow records a specimen from Fort Riley, Kansas.

Pituophis catenifer, Blainv., var. bellona, B. & G.: Western Bull Snake.—This species also is recorded from Fort Riley in Dr. Yarrow's Check-list.

Elaphis quadrivitattus, Holbr.: Chicken Snake.—Dr. Yarrow's record, "Kansas" for this snake, adds another southern species to a fauna which, though a *prairie* fauna, has already shown that it has much in common with the Austroriparian.

Cyclophis æstivus, Linn.: Southern Green Snake.—Among the specimens submitted by Col. N. S. Goss is one of this species. It is from Neosho Falls. A second specimen of uncertain locality in the collection of the Topeka Free Library was presented with other Kansas specimens, and was probably taken in Kansas. A third specimen seems to have been taken at Great Bend by Messrs. E. G. Buckland and H. B. Torrey. This is another Austroriparian species.

Tantilla Hallowellii, Cope: Hallowell's Tantilla.—This species was originally described in 1856 as a variety of *T. gracilis* by Dr. Hallowell from a specimen collected in Kansas by Dr. Hammond, (Proceed. Phila. Acad. Nat. Sci., 1856, p. 246,) and afterwards named as distinct by Prof. Cope. (Proceed. Phila. Acad. Nat. Sci., 1860, p. 77.) Mr. Garman, of the Cambridge Museum of Comparative Zoölogy, in his excellent account of the *Ophidia* of North America, "North American Reptiles, Part I," reduces it to a variety under *T. gracilis*. As it does not appear that any of the allusions to this species have been based upon more than one or two specimens, it seems necessary to await the accession of further material before the specific identity of *Hallowellii* with *gracilis* can be either asserted or denied.

Sistrurus catenatus, Raf.: Massasauga.—Taken in Ford county by the writer. It is recorded from the Verdigris river [Kansas?] in Dr. Yarrow's Check-list. The Ford county specimen is typical, and the locality is the most westerly known for the species. This is the *Caudisona tergemina* (erroneously printed "tergermina" in my "Preliminary Catalogue.") Mr. Garman's substitution of a fourth generic name in the stead of either of the three to which the plated-headed rattlesnakes had previously been referred, seems to have been the proper and indeed the only logical remedy for the confusion that existed, inasmuch as no new genus, nor even sub-genus, had previously been created for those forms, the generic names previously used for them being preoccupied and long used with a very different signification.

Amblystoma microstoma, Cope: Small-mouthed Salamander.—A specimen of this salamander occcurs in Col. N. S. Goss's contribution. Its locality is, not quite certainly, but probably, Neosho Falls.

Necturus maculatus, Raf.: Water Puppy.—Several specimens from Neosho Falls, in the collection submitted by Col. Goss, are the first Kansas specimens that I have seen. The species was previously reported to me in letter by Prof. F. H. Snow, who stated that it had been taken in Allen county, near Iola, by Mr. Bert Casmire, a student of the State University.

The minuter details of the relations of Kansas to the four great faunal regions—Central, Eastern, Austroriparian, and Sonoran—that enter or approach its borders, are yet to be ascertained.

In problems of faunal relations, we can direct our attention to no department of zoölogy more profitably than to that of herpetology, the intimate relations of reptiles and batrachians to their climatic and topographical surroundings (partly dependent on the fact that they do not migrate), rendering them exceptionally important factors in all problems of faunal relations.

This fact has constantly been kept in mind in my studies of the reptilian fauna of Kansas, and the conclusions primarily derived from the study of that fauna have been frequently reviewed in the light of observations made in the course of my studies upon other groups of Kansas vertebrates and invertebrates, and further tested by the published writings of the various naturalists who have studied portions of the Kansas fauna.

While Kansas embraces features of each of the four faunal regions above mentioned, no part of its territory is the exclusive property of one. Faunal regions are rarely sharply defined. They cast their shadows beyond them, and beyond each shadow is spread a penumbra. To a mingling of faunal shadow and penumbra from the regions above mentioned this area owes the heterogeneous aspect of its fauna.

In its flora, too, we see mingled with the dominant vegetation of the Central and Eastern regions varying shades of the Austroriparian, and a few faint flecks of the Sonoran.

Of reptiles and batrachians, whose distribution corresponds nearly with a single one of the four regions concerned, or with a part of such region, we find in Kansas of the Austroriparian 14, Central 11, Eastern 10, and Sonoran 3.

This observation might seem to point to the Austroriparian as the dominant factor, but it by no means represents the true faunal relations of the State. It plainly asserts that the fauna of Kansas is deeply shaded with Austroriparian. But when we consider the ratio of each of the above numbers to the entire number of species peculiar to the corresponding region, and take into account species common to two or more regions, we see at once that the herpetological aspect of Kansas is mainly Central and Eastern.

Two or three, only, of the many reptiles characteristic of the Sonoran region, together with a few which that region shares with the Central on one hand, or with the Austroriparian on the other, extending into Kansas, show its distant Sonoran relationship.

The above observations pertain to the Kansas fauna as a whole, all Kansas species being viewed as common to the entire State. But comparatively few species range over the entire area of Kansas in upland and valley alike, and to gain an adequate conception of the Kansas fauna, even in its relations to natural faunæ, we must consider its intralimital relations, and take into account other groups than those of reptiles and batrachians.

Full details of distribution have as yet been made out for but few species of Kansas animals; but enough has been done to warrant the following conclusions as to the special relations of the Kansas fauna:

1. That Kansas cannot, as a whole, be included in any single faunal region of the four that enter or approach its borders.

2. That it possesses some faunal features in common with each of these regions.
3. That the only faunal region that contributes a considerable majority of its characteristic species to any portion of Kansas, is the Central.
4. That the plains of Kansas, west of the ninety-seventh meridian, possess a large majority—in reptiles and batrachians, perhaps all—of the characteristic species of the Central region, and that while the Central fauna cannot be regarded as extending in full force, except locally, over the plains east of that meridian, many of its characteristic forms occur abundantly further east, some of them ranging to the Missouri river.
5. That even in the purest portions of the Central fauna in Kansas, appear slight manifestations of Sonoran, and others of Eastern and Austroriparian affinities.
6. That the prairie fauna of Kansas, east of the ninety-seventh meridian, is a heterogeneous assemblage of Central, Eastern, and Austroriparian forms, among which the Central predominate.
7. That it is on the "bottoms" and wooded bluffs, and their immediate vicinity, that the constituency of the Eastern fauna in Kansas is mainly expressed, and that this constituency includes comparatively little that is really characteristic of the aquatic phase of that fauna, while representing fairly well the terrestrial aspect of the same.
8. That the lacking elements of the Eastern fauna in these low and wooded tracts, are largely replaced, in valleys of the Missouri drainage, by Central, and in those of the Arkansas drainage, by Austroriparian and Central elements.
9. That the constituency of the Eastern fauna in Kansas diminishes westward, and is nearly or quite lost in the Central ere it reaches our western border.
10. That the Kansas constituency of the Austroriparian fauna lacks numerous characteristic forms of that fauna, and is constantly intermingled with Eastern and Central elements.
11. That this constituency is fullest in the valleys of the lower Arkansas drainage —notably of the Spring, Neosho, Verdigris, and Fall rivers—and represents only the Louisianian and Texan districts.

PRELIMINARY NOTE ON THE ORIGIN AND MATURATION OF THE OVUM IN PORCELLIO.

BY F. W. CRAGIN, SC.B.

The early history of the ovum in *Arthropoda* is of peculiar interest in relation to Balfour's theory of polar globules.

In the winter and spring of 1881–2, I undertook an investigation regarding the fate of the germinative vesicle in *Porcellio*, two writers (whose names now escape me) having claimed to have witnessed a polar globule in this or an allied isopod genus, but their statements being not sufficiently detailed to inspire confidence that the phenomenon witnessed was actually what they inferred it to be.

While the results of my studies were far from conclusive (and I have since been unable to resume the investigation), they indicate that events at least *potentially equivalent* to the formation of polar globules—viz., degradation and partial elimination of the germinative vesicle—*probably* take place in the maturation of the ovum in *Porcellio.*

The ovary in *Porcellio* is a subcylindrical sac, constituting a conspicuous anatomical feature on either side of and parallel to, the alimentary canal. When not distended with eggs, its diameter parallel to the axis of the upper oviduct is contained seven or eight times in its length. Its wall is a thin, transparent and colorless membrane, apparently syncytial, though perhaps really a pavement epithelium with delicate and but slightly differentiated cell-walls.

The nuclei are lenzitoid and extremely flattened. Seen from above, they present various subcircular outlines, which are often asymmetrical. The nucleoli are comparatively small, though well defined, and are often excentric.

In the suspensory ribbons, which are simply elongations of the ovary wall, the sparingly present nuclei are so distributed as apparently to forbid a cellular structure—several nuclei being often huddled together in one part of the ribbon, while in adjacent intervals there are none at all.

The oviduct is placed somewhat nearer the posterior than the anterior end of the ovary, its walls being composed of broadly columnar epithelium, and its ovarian end being inflated to form a receptaculum seminis, whose junction with the ovary, being in the line of the germogen, divides the latter into an anterior and a posterior arm.

Whether of syncytial or cellular origin, numerous germinal cells may be seen in the germinal tract of the *Porcellio* ovary, and since these appear to originate from indefinite germ-like bodies, the term germogen may be conveniently retained.

In the smaller germinal cells the nucleus is relatively small, sometimes even indistinguishable, but in those which are destined to become eggs, the nucleus grows more rapidly than the cell-body, and is at length relatively large. Prior to the escape of the germinal cell into the general ovarian cavity, its nucleus is seen to be surrounded with a densely granular zone which, spreading outwardly as the cell grows, at length reaches the cell-wall.

In the course of this growth, the nucleolus sometimes divides into two or three similar and smaller nucleoli, and the eggs themselves become invested with a follicular epithelium. This consists of small ovate to cylindrical cells, arranged in columnar fashion in a single (or in part double) layer, closely investing each ovum, the polygonal spaces thus temporarily left being usually occupied by a few isolated cells similar to those of the follicles. The entire follicular structure is definitely limited by a layer of cells quite like that which constitutes the several follicles, and, in fact, partly composed of the outer portions of those follicles. The cells destined to form the follicles are at first loosely scattered in the region about the ovum to which latter it would seem that they migrate later. Their final origin was not determined. As they attain maturity, the ova become more or less polygonal by pressure and are then usually arranged in two rows, with rarely a part of a third completely filling the ovary. Some of them undergo retrogressive development, the function of such retrogression being probably connected with nourishing the true ova, this being partly accomplished also by the follicular epithelium, and perhaps further aided by the product of a peculiar gland-like streak* which extends along the side of the ovarian tube opposite that which the germogen occupies, appears to be of protoplasmic nature, though of yellowish brown color, contains numerous scattered granules and larger irregular and ill-defined masses, and possibly represents a functional vitellarium.

In this rapidly growing condition of the ovarian egg the germinal vesicle is central in its position, and relatively large as compared with the ovum. After the ovum has attained its growth, the germinal vesicle leaves the center, becoming relatively smaller and at last reaches the surface of the ovum. There is apparently a narrow liquid zone between the outer limit of the protoplasm of the egg and the chorion, and I have not observed the nucleus to pass entirely across this zone so as to be in actual contact with the chorion. I have, however, observed it to push out into this space, the projected portion still covered with a thin layer of granular protoplasm, and thus making a considerable protruberance. Whether this was really what it seemed to be, viz., a preliminary

---

*This streak was noticed only while the ova were in process of maturation. While cellular structure, such as may be observed in most glands, was not made out, it may have been present, obscured by the cell products, as the streak was not studied in section. I first thought the structure to be of a *detrital* nature, as further investigation may yet prove it to be.

step in the elimination of a polar globule or its functional equivalent, liquid or solid, I cannot say, as I was unable to pursue the investigation further at that time. But until further study of the fate of the germative vesicle can be made, I hold the provisional opinion that this migration and protrusion, taken in connection with the condition of the germative vesicle in this and other ova simultaneously taken from the same ovary and treated with picro-carmine, represented an initial phase of such an elimination.

The germinative vesicle of the particular ovum concerned in the above-mentioned protuberance had, at the time of that protuberance, one large and several accessory nucleoli, of which the former, at least, had one large vacuole.

The following is an account of the general appearance presented by the germinative vesicle in this and other ova of the same brood, the growth of all of which must have been arrested at nearly the same stage of development: It possessed a distinct but thin, transparent and flaccid limiting membrane. Visible beneath this membrane was a broad-meshed, but most delicate, lattice, composed of exceedingly fine granules — much finer than those in the protoplasm of the general egg body — and appearing much like a dissolving remnant of the intranuclear trestle*. There were in each instance, besides the large nucleolus, several, sometimes upwards of thirty, accessory nucleoli. There was a marked relation between the number of these accessory nucleoli and their size. When numerous, they were all small; when few, two or three of them, at least, were relatively large. Both principal and accessory nucleoli were vacuolated. In a germinative vesicle with but eight accessory nucleoli, the principal nucleolus had one large vacuole of subangular outline, about which were other and minute vacuoles. In those with numerous accessory nucleoli, the vacuole had become so extremely large that the solid part was reduced to a spherical shell, converting the nucleolus into a mere vesicle, its wall, however, still much thicker than that of the germinative vesicle itself.

As migration of the germinative vesicle to the periphery of the ovum is a constant and indeed necessary step in the elimination of polar globules or their potential equivalents, and as this migration is universally accompanied by metamorphosis of the germinative vesicle, more or less distinctively retrogressive; and particularly in view of the researches of Van Beneden and Fol, who have shown that in the ovum of *Asteracanthion* the formation of nucleolar vacuoles and accessory nucleoli are phenomena characteristic of such retrogression, I regard it as probable that the migration and metamorphic appearances above noted indicate the ultimate partial elimination of the germinative vesicle in *Porcellio.*

I am by no means confident that the extreme aspect of the vacuolation which I have recorded was not an effect of the staining-reagent; but thus to explain the concomitant phenomena, is hardly possible, and the most reasonable conclusion seems, therefore, to be that to which I have already pointed, a conclusion which, I must humbly confess, lacks that most desirable element in scientific deductions—*certainty.* It is, then, with the hope that this conclusion may ere long be either verified or refuted by new experimental evidence, that it is here presented.

BOTANICAL ADDENDA FOR THE YEARS 1883 AND 1884.

BY PROF. J. H. CARRUTH, LAWRENCE.

The work of making a catalogue of the plants of Kansas is so nearly completed, and my salary as a State officer is so very meager, that I have done but little myself. I have found one plant, and two have come up in my garden. Mr. E. Bartholomew, of Rock-

---

*This trestle, or network, is a well-defined structure in the earlier history of the ovarian egg of *Porcellio.*

port, Rooks county, has been busy as heretofore with the plants of his county, and sent me the results, but few are new. Mr. Joseph Henry, of Salina, has sent me a few. The greater number (all but about ten) have come through the labor of Dr. J. H. Oyster, of Paola, Miami county, who has traveled in the south and west, as well as observed carefully in his own county. E. N. Plank, Esq., has traveled extensively, but I am unable to give the results of his observations.

Those not in Gray nor Wood, I mark with a †.

†1474. Helianthemum capitatum Nutt.; Linn county. Viola pubescens, var. eriocarpum Nutt.; W. Kansas. Ionidium lineare, reported doubtfully before, found in Wilson county.

†1475. Æsculus arguta Buckley. Lyon county and W. Kansas.
1476. Lespedeza angustifolia L. Miami county. Sometimes a var. of L. capitata.
1477. Trifolium stoloniferum Muhl. Miami county.
1478. Proserpinaca palustris L. Miami county.
1479. P. pectinata Lars. Miami county.
†1480. Œnothera linifolia Nutt. Labette county.
1481. Ludwigia polycarpa. Short and Peter. Miami county.
†1482. Cyclanthera dissecta. Garden. Lawrence.
†1483. Aster Drummondii Lindl. Miami county.

1484. Silphium terebinthaceum L. Reported as seen in Marion county by Mr. Frank Bush.

†1485. Aphanostephus Arkansanus Gray. Reported in the flora of N. A. as found in Kansas.

†1486. Boltonia latisquama Gr. Found near the mouth of Kansas river by Dr. C. C. Parry.

†1487. Franseria tomentosa Gr. W. Kas.
†1488. Artemisia annua. Garden and street, Lawrence.
1489. Artemisia caudata Mx. Miami county. (?)
†1490. Pyrrhopappus scaposus D.C. Miami county. (?)
1491. Arctostaphilus uva-ursi Spreng. Council Grove.
1492. Lysimachia quadrifolia L. Miami county.
1493. Plantago Rugelii Dcne. Lawrence.
†1494. Lycopus lucidus, var. Americanus Gr.
†1495. Heliotropium tenellum Torr. E. Kan.
†1496. Solanum Torreyi Gr.
†1497. Asclepias stenophylla Gr. E. Kan.
†1498. Polygonum camporum Meisn.

†1499. Chenopodium Berlandieri Moq. Common. Heretofore supposed to be a small variety of C. alba.

1500. Euphorbia prostrata Ait. Miami county. Common, but not in Gray nor in Wood's Botanist and Florist, and therefore supposed to be thought a var. of E. humistrata.

†1501. Tragia ramosa Müll. Rooks county.
†1502. Argyrothamnia mercurialina Müll. Wilson county.
1503. Croton glandulosus L. Johnson and Sumner counties.
1504. Phyllanthus Carolinianus Walt. Miami county.
1505. Potamogeton amplifolius Tuck.
1506. Amianthium muscætoxicum Gr. Butler and Sedgwick counties.
†1507. Allium Nuttallii Watson.
†1508. Androstephium violaceum Torr. W. Kansas.
1509. Uvularia perfoliata L. Wyandotte county.

†1510. Carex marcida Boott. Rooks county.
1511. C. hystricina Willd. Salina.
†1512. Polypogon littoralis. Salina.
†1513. Aristida desmantha Rupt. Harper county.
1514. Eragrostis Purshii Schrad. Harper county and Salina.
†1515. Triticum glaucum. W. Kansas.

ERRATA.

Page 110, 21st line, for "gomatites" read *goniatites*; in 32d line, for "prunes" read *prunus*.